DATACOMPUTER SUPPORT OF SEISMIC DATA ACTIVITY

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DATACOMPUTER SUPPORT OF SEISMIC DATA ACTIVITY

Quarterly Technical Report

May 1, 1975 to July 31, 1975

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1. Summary

1.1 Project Goals

The purpose of this project is to support the ARPA-NMRO Seismic Data Activity by providing data storage and retrieval services. The Arpanet will be used as the primary communications channel. As part of the service, seismic data will be (a) received from the Arpanet; (b) stored and indexed in the Datacomputer; and (c) made available to computers on the Arpanet in a convenient and timely manner. These services represent a special application of the Arpanet Datacomputer being developed and maintained by Computer Corporation of America (CCA) under Contract No. MDA903-74-C-0225.

The amount of seismic data to be kept on-line requires the addition of a mass memory to the Datacomputer system. An Ampex Terabit Memory System (TBM) with a capacity of almost two hundred billion bits will be installed at CCA in January 1976 to answer this need. Modifications to CCA's computer site are necessary for the TBM.

The other hardware item vital to this project, besides the TBM, is a small Seismic Input Processor (SIP). The SIP will perform several functions, the most important of which is to continuously collect data over the network, reformat and buffer the data, and, at regular intervals, generate a datalanguage update request and burst the data to the Datacomputer via the local CCA network node. It will be necessary to replace the CCA TIP as the local network node with an IMP to provide the required bandwidth.

1.2 Technical Status of the Project

Project activity can be divided into four areas: (1) SIP development and network bandwidth considerations; (2) coordination with the seismic community; (3) TBM acquisition and integration into the Datacomputer; and (4) seismic related Datacomputer development.

The SIP consists of a DEC PDP-11/40 with 28K core, two RP04 disks and an Arpanet host interface. All of this SIP hardware has been installed and connected to the network. Software development is underway and modifications to the CCA local network node due to bandwidth considerations have been planned.

In continuing coordination with the seismic community, new versions of the CCP-SIP Protocol and proposed seismic Datacomputer file structures were received by CCA. After study, a reply listing a number of minor problems and errors was sent concerning the CCP-SIP network protocol. At the end of this quarter, the third edition of the seismic file structures was under study by CCA.

The TBM memory system is being built by Ampex Corporation as a subcontractor to CCA. The initial TBM configuration will be one transport driver, two dual transport modules, one data channel and a Communications and Control System (CCS). All components except one transport module and the CCS have undergone stand-alone testing. Ampex has informed CCA that delivery of the complete TBM system will be in January 1976.

A new version of the Datacomputer was released with many new features useful in seismic data activity. The primary features that will be necessary for staging and use of the TBM were designed and partly coded.

2. The SIP

Seismic array data will be collected from the Arpanet, buffered, and reformatted by a small Seismic Input Processor (SIP) which will retransmit the data to the Datacomputer (see Fig. 1). The SIP is equipped with disk storage adequate for 24-hour buffering of a 15 kilobit per second data stream.

2.1 The Software

Utility programs for loading and dumping the SIP over the Arpanet and debugging programs on the SIP have been completed.

The division of the SIP task into submodules has been refined and detailed. Several design documents and an implementation schedule have been written. This implementation schedule forecasts later completion of an operational SIP system than hoped previously, due to delays already caused by late delivery of host interface equipment by BBN for connecting the SIP to the CCA TIP and prolonged hardware difficulties with the SIP disks.

The possibilities of using a commercially available monitor system for the SIP were investigated. Based on its specifications as documented, DEC's RSX-11M real-time monitor was selected as an acceptable framework that already contained disk routines for the RP04 disk with which the SIP is equipped.

2.2 Proposed IMP-TIP Swap

Fifteen to twenty kilobits per second (kbps) of seismic array data will flow continuously from the CCP to the SIP according to the most recent seismic file formats document received from VSC. This data is buffered in the SIP and, to provide for catch-up from Datacomputer down time, recovery from errors, and to avoid tying up a Datacomputer subjob all the time, the data should be burst from the SIP to the Datacomputer at four to five times this rate. About 4 kbps average of non-array seismic data will be sent to the Datacomputer through the Arpanet not using the SIP and a similar compression factor of four or five

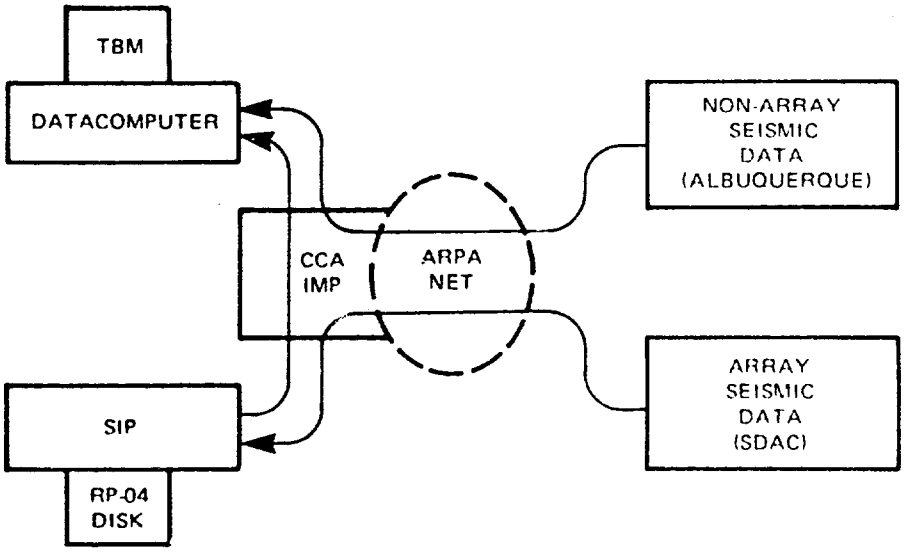

Figure 1--Seismic Data Flow

should be allowed here. This totals a desired 91 to 140 kbps, of which 60 to 100 kbps would be local traffic, excluding seismic data retrievals, non-seismic Datacomputer traffic, and network through traffic. Measurements had previously indicated saturation of the CCA TIP at 50 to 80 kbps of traffic instead of the expected 300 kbps claimed by BBN as an IMP's capacity.

This problem was investigated by BBN and CCA and several experiments to explore and isolate the causes of the problem were conducted by CCA and the NCC. The problem was primarily accounted for by lack of available processor power and buffer space in the CCA TIP. Processor power problems are primarily due to the amount of TIP processor time taken serving the TIP terminal ports and secondarily to excessive time handling network routing messages. The buffer space problems are primarily due to the Lincoln Laboratories VDH interface to the CCA TIP which requires a disproportionate amount of buffer space.

It would appear that swapping the CCA TIP and its terminal lines with the MIT-IPC IMP and moving the Lincoln Laboratories VDH host interface to another IMP or TIP would substantially solve this problem.

2.3 The Hardware

Some hardware difficulties were encountered with the SIP. Continued infrequent and sporadic problems with the RP04 disks were carefully recorded. Analysis of these records traced the problem to a subtle defect in the disk head positioning mechanism which was confirmed and corrected by a national level disk expert from the supplier (Digital Equipment Corporation).

The SIP was connected to the ARPA network as a host and its IMP-11A interface checked out. One hardware problem was found in the IMP-11A and fixed.

3. Coordination with Seismic Community

We have received a new set of file descriptions that, for the first time, give descriptions of all of the seismic files and give average data rates of storage into the files and some datalanguage to create the files. All of this is being reviewed with a view toward efficiency, convenience, and flexibility. None of the new features of the most recent Datacomputer version are used in these files and some of them may prove advantageous.

4. The TBM

An Ampex Terabit Memory System (TBM) will be part of the Datacomputer to provide the required large amount of on-line storage. The TBM requires site modifications at CCA.

4.1 Software Specifications

The TBM at CCA will be designed to interface to an IBM 370 block multiplexor channel and operate, with a number of additional commands and differences, analogously to a disk storage or similar memory system. An adapter already on the Datacomputer provides the IBM equivalent channel to which the TBM will be attached. This differs from other "back-fill" terabit memory schemes, where data communication is entirely by shared disk. Using the TBM more directly as a device is both simpler and more powerful.

TBM tape blocks have additional information associated with them, recorded in a "tally track". This additional information includes a count (for the block) of physical passes with the data heads engaged (used for determining tape wear) and a file-id number which may be set by the Datacomputer. The file-id is to be used as an error check for data operations. Ampex's initial software specifications omitted a way for the Datacomputer to read the tally track information and did not properly implement the file-id checking features.

The Datacomputer is to have centralized automatic error recovery for most error conditions and substantially unattended operation. Ampex's initial software specification omitted a command through the Channel Interface Unit (CIU) that connects to the Datacomputer's IBM equivalent channel for the head realignment operation sometimes used in error recovery on TBM drives. This operation was (and will be) available to the TBM operator via the TBM system control processor.

Ampex will revise the software specifications to fix these problems.

4.2 Site Preparation

The CCA computer site needs enhancement to accommodate the TBM and SIP. These requirements having been determined, Control Data Corporation was selected as general contractor based on solicited bids.

Written agreement has been reached on all major aspects of the site work and has, in turn, been given Government approval. Verbal agreement on all details have been reached with Control Data Corporation (CDC) and, at the end of this quarter, CCA was waiting for a detailed contract to be drafted by the contractor and for Government approval of a list of ASPR regulations to include in such a contract.

4.3 The Hardware

The TBM consists of two parts: (a) a Data Storage Section (DSS), which is the repository of all data stored within the TBM; and (b) a Communications and Control System (CCS), which provides message and data interfaces between the PDP-10 and the TBM (see Fig. 2).

The CCS, in turn, consists of a system control processor which is a DEC PDP-11/40, a Transport Driver Interface unit (TDIF) and a Channel Interface Unit (CIU). At the next level of detail, the CIU consists of a CIU controller, the Data Channel Interface (DCIF) which talks to the TBM's internal data channel, and the Host Computer Interface (HCIF). The CIU HCIF presents the appearance of an IBM 370 block multiplexor channel device and connects the TBM to the Datacomputer's Systems Concepts' SA-10 IBM channel interface. The DSS consists of two dual transport modules, a transport driver, and a read-write data channel.

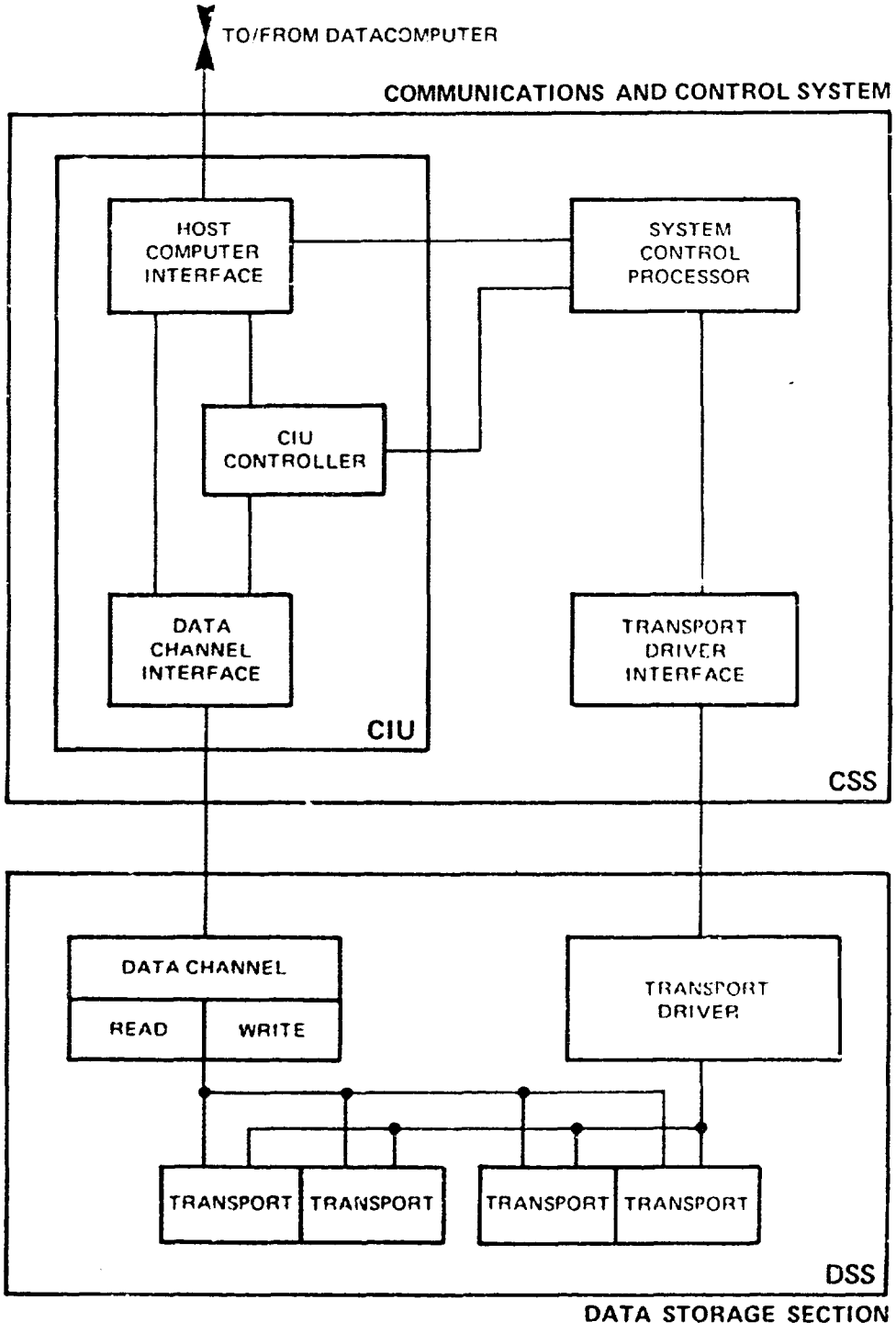

Figure 2--TBM Structure

In July, Ampex informed CCA that delivery of the TBM would be delayed until January 1976, five months after the contractual delivery date of August 12, 1975. The reason for this was severe difficulties with the CIU, particularly its HCIF subpart. Ampex originally intended the CIU controller to be an LSI-11 computer, but changed to a PDP-11/05, with different interfaces, due to delivery uncertainties and difficulties with the LSI-11.

5. The Datacomputer

During this quarter, the Version 0/11 Datacomputer was phased out and Version 1 became the operational Datacomputer. The new Datacomputer contains a number of advances of use to the seismic application. Besides a number of minor changes to speed up the Datacomputer, Version 1 has a set of special routines that recognize some simple data storage and retrieval operations not requiring reformatting or conversion and perform these operations particularly rapidly. Version 1 also had a number of improvements and generalizations in allowable file descriptions.

For many Datacomputer requests to store or retrieve information to or from the TBM, information will have to be staged on disk storage. The seismic files are very large, usually covering real time periods of a month or day, and it will be highly desirable for them to be updated by appending information while one or more users are reading the same file. A set of routines called SDAX have been designed to keep track of the location and status of multiple copies and versions of a file so as to answer both the staging and multiple readers while updating need.

Glossary

ARPA	Defense Advanced Research Projects Agency
ASPR	Armed Services Procurement Regulations
BBN	Bolt Beranek and Newman Inc
CCA	Computer Corporation of America
CCP	Communications and Control Processor--at SDAC
CCS	Communications and Control System--part of the TBM
CDC	Control Data Corporation
CIU	Channel Interface Unit--part of the CCS
DCIF	Data Channel Interface--part of the CCS
DEC	Digital Equipment Corporation
DSS	Data Storage Section--part of the TBM
HCIF	Host Computer Interface--part of the CCS
IBM	International Business Machines Corporation
IMP	Interface Message Processor
Kbps	Kilobits per second
LSI	Large Scale Integration
MIT-IPC	Massachusetts Institute of Technology--Information Processing Center
NCC	Network Control Center
NMRO	Nuclear Monitoring Research Office--part of ARPA
SDAC	Seismic Data Analysis Center--Alexandria, Virginia
SDAX	Special Disk Area Index
SIP	Seismic Input Processor--at CCA
TBM	Terabit Memory System
TDIF	Transport Driver Interface--part of TBM
TIP	Terminal Interface Processor
VDH	Very Distant Host
VSC	Vela Seismological Center

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